Avian Species Monitoring on the Nez Perce – Clearwater National Forest

2017 Final Report

Snag visited by Northern Flicker on route WHWO-052, Robert Miller, April 19, 2017

October 15, 2017

Challenge Cost Share Project No. 15-CS-11011700-044
USDA Forest Service – Nez Perce-Clearwater National Forest
Boise State University Award Number 70600-1000346

Prepared by:
Robert A. Miller, Caleb Hansen, and Jay D. Carlisle

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Introduction

The USDA Forest Service identifies management indicator species (MIS) as indicators of forest health (Landres et al. 1988). These species are often chosen to represent specific habitat types within the forest and, to be most effective as indicators, tend to be sensitive to changes within the forest. The Nez Perce - Clearwater National Forest (NPCNF) has a number of identified management indicator species (Dinkins et al. DRAFT). Additionally, the USDA Forest Service has an obligation to manage threatened, endangered, and sensitive species (USDA Forest Service 2011). Sensitive species are formally classified by the Forest Service as species that require special management to enhance their population to prevent a need for listing as threatened or endangered (USDA Forest Service 2011).

Beginning in 2016, through a partnership with the Nez Perce-Clearwater National Forest (NPCNF), the Intermountain Bird Observatory (IBO) began surveying for avian Management Indicator and Sensitive Species within the forest. Our efforts in 2016 focused on five species including three management indicator species – Northern Goshawk (*Accipiter gentilis*), Belted Kingfishers (*Megaceryle alcyon*), and Pileated Woodpecker (*Dryocopus pileatus*) – and two other sensitive species – White-headed Woodpecker (*Picoides albolarvatus*) and Mountain Quail (*Oreortyx pictus*). The Belted Kingfisher efforts were dropped in 2017, focusing instead on increased effort on the remaining four species. This document presents the findings of the 2017 effort.

Common Methods

For all four species we utilized a common set of methods based upon spatially-balanced random sampling. The results of the random sampling are used for all statistical inference. At the request of the NPCNF we also checked and surveyed a select group of historical Northern Goshawk territories.

Survey Site Selection

For each of the four species' random surveys, we first created species-specific strata to be sampled. The strata for Mountain Quail and White-headed Woodpeckers were decreased in size from their 2016 definitions in the hopes of surveying higher quality habitat and thus increase the number of detections. The stratum for Pileated Woodpecker was increased in size from the 2016 stratum to compensate for the decreased size of the White-headed Woodpecker stratum. The result is that we expected the measured occupancy rates within the strata to be higher than 2016 for Mountain Quail and White-headed Woodpecker, and equal or slightly lower for Pileated Woodpeckers. The stratum for Northern Goshawk remained unchanged between years, thus we expect no changes in occupancy rates for goshawks.

Within each stratum, we performed a spatially-balanced draw of 1-km by 1-km square grids using a generalized random-tessellation stratified (GRTS) design (Stevens Jr. and Olsen 2004). This protocol generated a prioritized list of spatially balanced 1-km × 1-km survey grids that enabled individual grids to be dropped from the survey while still maintaining a balanced design. The balanced design holds true as long as grids are not systematically removed, which can introduce a systematic bias.

We manually evaluated each proposed survey grid, removing grids located on private land, and grids that required a hike of greater than four miles from the nearest access point. These filters introduced a systematic bias in the results favoring grids on public land and with reasonable access. This bias was considered acceptable given cost/benefit concerns. Within each 1-km grid square, we placed nine survey points 333m apart and 166m from the edge of the grid (Figure 1).

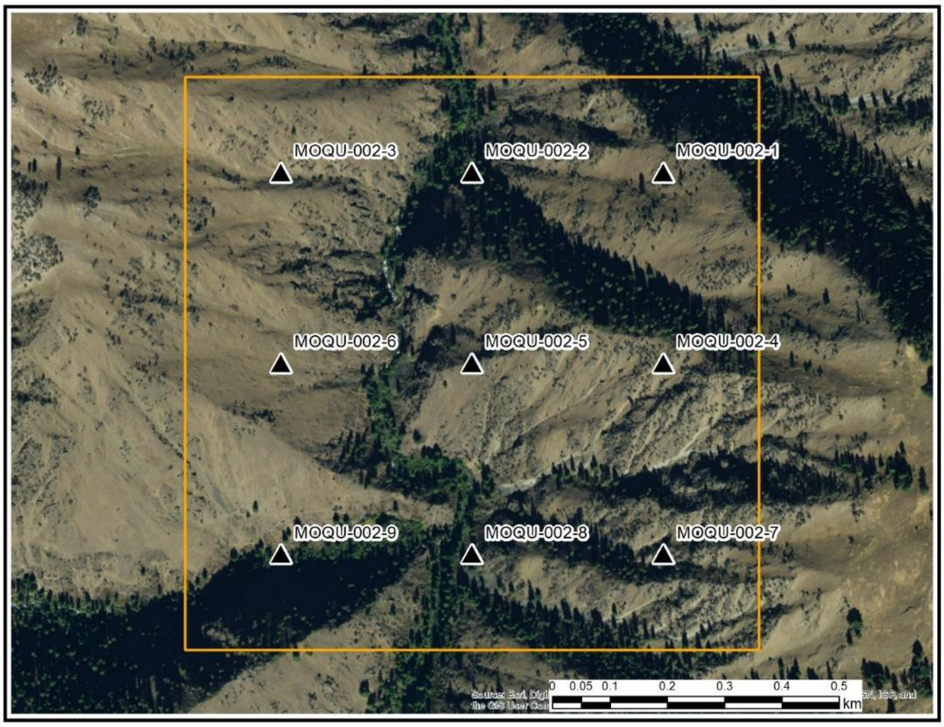

Figure 1. Example illustrating nine survey points, each separated by 333m, within a 1-km square sampling grid.

Field Surveys

With the exception of early season training for the team, each grid was surveyed by a single individual. For Mountain Quail and the woodpeckers, surveys began 15 minutes prior to local sunrise and completed within five hours after local sunrise. Each surveyor completed as many of the nine survey points within the grid that could be safely accessed and completed within the 5.25-hour survey period. The Northern Goshawk surveys had no such time constraint. At each survey point, the surveyor completed the observation period specific to the species (e.g., three broadcast/listen intervals for Mountain Quail), and documented the habitat composition surrounding the point.

Multi-scale Occupancy Analysis

All analyses include a combination of surveyor-collected habitat data and data extracted from GIS sources such as digital elevation models (DEMs) and Forest Service Inventory layers (e.g., VMap vegetation layer; Brown and Ahl 2011). We performed multi-scale occupancy modeling as the primary analysis method (Nichols et al. 2008, Pavlacky Jr. et al. 2012). For most species, we implemented a interval-by-interval replacement design (two-minute intervals for Mountain Quail and Northern Goshawk, one-minute intervals for woodpeckers), allowing for simultaneous evaluation of detection, point-scale occupancy, and transect-scale occupancy (Nichols et al. 2008). For Northern Goshawk surveys, we used a removal design instead of a replacement design to minimize the length of disturbance to nesting goshawks (i.e., we ceased broadcasts after a detection). Similar to Pavlacky et al. (2012) we used a modified version of Nichols et al. (2008) where the point-scale occupancy uses spatial replicates. Some surveys include only broadcast protocols (e.g., Mountain Quail and Northern Goshawk), and some contain a combination of silent and call broadcast (Pileated and White-headed Woodpeckers).

We evaluated day-of-year, time-of-day, cloud cover, and wind speed as covariates influencing the probability of detection in all models. In multi-scale occupancy models, the probability of detection is the probability of detecting at least one bird of interest at a point given that at least one of the birds of interest was available at the point during the survey (p). We evaluated many landscape and habitat variables as predictors of a point being occupied by at least one bird of interest given that at least one bird of interest was occupying the transect (Θ). Transect-scale landscape and habitat variables were evaluated for influencing the presence of at least one bird of interest on the transect (Ψ). Due to our limited sample size of detections with some programs (e.g., Mountain Quail), we were not always able to evaluate covariates predicting overall transect occupancy (*Ψ*) for these species, however, within this modelling approach, point-scale occupancy (*Θ*) can be used as a surrogate as far as habitat preferences are concerned (Pavlacky et al. 2012).

We ranked occupancy models using Akaike Information Criterion adjusted for small sample size (AIC_c; Burnham and Anderson 2002). We first selected candidate variables influencing the probability of detection (*p*) by considering all combinations of the variables and chose all variables appearing in models within two ΔAIC_c of the top model. We then fixed the variable set for probability of detection and repeated the procedure for variables influencing the occupancy at the point-scale (Θ). If we had sufficient sample size, we also evaluated variables influencing transect occupancy (Ψ).

For inference, we used model averaging of all models falling within two ΔAIC_c of the top model, that also ranked higher than the null model (Burnham and Anderson 2002). For each variable appearing within this final model set, we created and present model-averaged predictions by ranging the variable of interest over its measured range while holding all other variables at their mean value.

Maximum Entropy (MaxEnt) Modeling

New for 2017 we added MaxEnt analysis for each of the evaluated species to produce a more flexible estimated distribution map. We started by producing study-wide raster maps for elevation, slope, roughness, and an ecological relevant sample of the 19 standard climate variables derived from 1970 – 2000 (worldclim.org; Fick and Hijmans 2017; Table 1). Roughness was calculated from the 30m digital elevation model and represents the difference between the maximum and the minimum value of a cell and its 8 surrounding cells. The climate variables are included as a proxy for habitat on a scale where we lacked specific plant composition data broadly on the landscape. All geographic values (elevation, slope, roughness) were resampled down to 30-second blocks (~1km; resolution of the climate data) using bilinear interpolation.

We used all presence and pseudo-absence observations (locations that we failed to detect the species of interest, but cannot be certain that they were absent) from both 2016 and 2017 to build the models. We evaluated the MaxEnt model feature classes (linear, quadratic, hinge) and regularization parameters (0.5 – 4.0) using AIC_c (Shcheglovitova and Anderson 2013).

Table 1. Climate, geographic, and habitat variables and source of variables included in MaxEnt analysis.

Variable	**Source**
Annual Mean Temperature (°C)	worldclim.org bio_1
Mean Diurnal Range (Mean of monthly (max temp - min temp)) (°C)	worldclim.org bio_2
Temperature Seasonality (standard deviation *100)	worldclim.org bio_4
Max Temperature of Warmest Month (°C)	worldclim.org bio_5
Annual Precipitation (mm)	worldclim.org bio_12
Precipitation of Wettest Month (mm)	worldclim.org bio_13
Precipitation of Driest Month (mm)	worldclim.org bio_14
Precipitation Seasonality (Coefficient of Variation)	worldclim.org bio_15
Elevation (m)	USGS DEM
Slope	USGS DEM
Roughness	USGS DEM

Analysis Software

We conducted all statistical analyses in Program R and Program Mark (White and Burnham 1999, R Core Team 2017). We used the R package "RMark" to interface between Program R and Program Mark for the multi-scale occupancy modeling (Laake 2014). We used R package "AICcmodavg" to rank all multi-scale occupancy models (calculating AIC_c), and to perform model averaging (Mazerolle 2015). We used R package "dismo" (Hijmans et al. 2017), interfacing with the MaxEnt software engine (Phillips et al. 2017), for all MaxEnt analysis. We used R package "ENMeval" for ranking and evaluating MaxEnt models (Muscarella ela. 2014).

Mountain Quail

After detecting Mountain Quail on only three routes in 2016, we reduced the stratum size by roughly 50%, focusing our 2017 survey effort in higher quality areas. As a result, we expected more detections and a higher estimated occupancy rate. In addition to the common analysis methods mentioned previously, we evaluated some additional covariates specific to Mountain Quail. We evaluated distance to water, distance to cover, shrub height, shrub cover, and the proportion of food-bearing shrubs (Brennen 1991). For our analyses, we considered the following as food-bearing shrubs for Mountain Quail – serviceberry (*Amelanchier alnifolia*), hawthorn (*Crataegus* spp.), currant (*Ribes* spp.), elderberry (*Sambucus* spp.), and snowberry (*Symphoricarpos* spp.; Brennen 1991).

We completed 50 surveys for Mountain Quail within the forest (Figure 2). Mountain Quail were detected on seven survey routes, up from three routes in 2016 (Figure 2; Table 2).

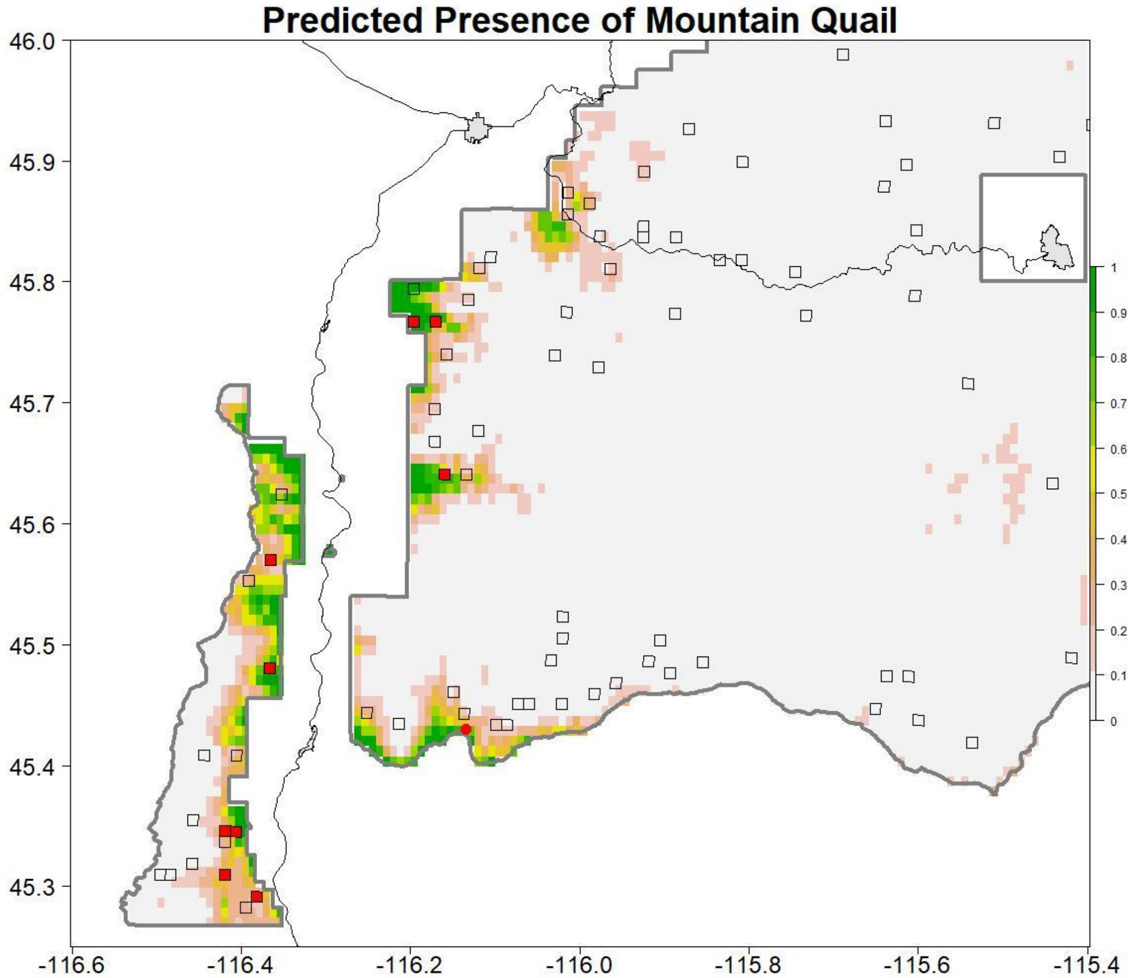

Figure 2. Completed Mountain Quail survey routes (squares), indicating presence (red) or no detection (hollow) overlaid on predicted Mountain Quail distribution resulting from MaxEnt model combining results from both 2016 and 2017. One incidental observation near Kelly Creek along the Salmon River also highlighted (red circle).

Table 2. Observations of Mountain Quail during 2017 survey efforts and the dominant understory near the point. All coordinates in NAD83 datum.

Route, Point	Date	UTM Northing Zone 11	UTM Easting Zone 11	Dominant Understory
MOQU-005, 1	5/2	5063833	565833	Ninebark (*Physocarpus* spp.)
MOQU-005, 5	5/2	5063500	565500	Ninebark
MOQU-005, 9	5/2	5063167	565167	Ninebark
MOQU-035, 4	5/3	5046500	549833	Ninebark
MOQU-035, 7	5/3	5046137	549833	Snowberry (Symphoricarpos spp)
MOQU-038, 6	4/4	5021500	546167	Ocean Spray (*Holodiscus discolor*)
MOQU-049, 4	4/13	5068500	564833	Willow species (*Salix* spp.)
MOQU-049, 6	4/13	5068500	564167	Ninebark
MOQU-051, 5	4/12	5036500	549500	Hawthorn (*Crataegus* spp.)
MOQU-051, 8	4/12	5036167	549500	Huckleberry (*Vaccinium* spp.)
MOQU-061, 3	4/12	5068833	562167	Hawthorn/ Red-osier dogwood (*Cornus sericea*)
MOQU-061, 5	4/12	5068500	562500	Wild rose (*Rosa acicularis*)
MOQU-061, 7	4/12	5068167	562833	Wild rose
MOQU-061, 8	4/12	5068167	562500	Hawthorn/Wild rose
Incidental	4/7	5031071	567703	

We evaluated traditional factors for their effect on the probability of detection such as day-of-year, time-of-day, and wind conditions (p). We evaluated variables such as shrub height, distance to cover, distance to water, and proportion of food-bearing shrubs as factors affecting point scale occupancy (Θ). Due to our limited sample size, we did not evaluate factors influencing transect occupancy (Ψ). The top model included only the proportion of food-bearing shrubs influencing point-scale occupancy, with no covariates for probability of detection.

Using the top model, we calculated the probability of detecting a Mountain Quail given that one was present (p) using call broadcast to be 0.22 ± 0.05 [95% CI: 0.14 – 0.32]. This detection rate is lower than 2016 (0.54 ± 0.15), but has a narrower confidence interval, thus we believe it is a higher quality estimate. The narrower confidence interval is the result of a larger sample size of detections in 2017 as compared to 2016.

We calculated point-scale occupancy (i.e., availability; Θ) to be 0.88 ± 0.16 [95% CI: 0.23 – 0.99]. Point-scale occupancy was influenced positively by the proportion of point-scale habitat composed of food-bearing shrubs (Figure 3). The wide confidence interval is the result of small sample size of detections and the fact that few points had a large composition of food-bearing shrubs (median percent was only 10%). Overall transect-scale occupancy (Ψ) was estimated to be 0.17 ± 0.06 [95% CI: 0.09 – 0.32]. This rate is higher that 2016 (0.07 ± 0.04 [95% CI: 0.04 – 0.21]) as expected with our narrower stratum definition.

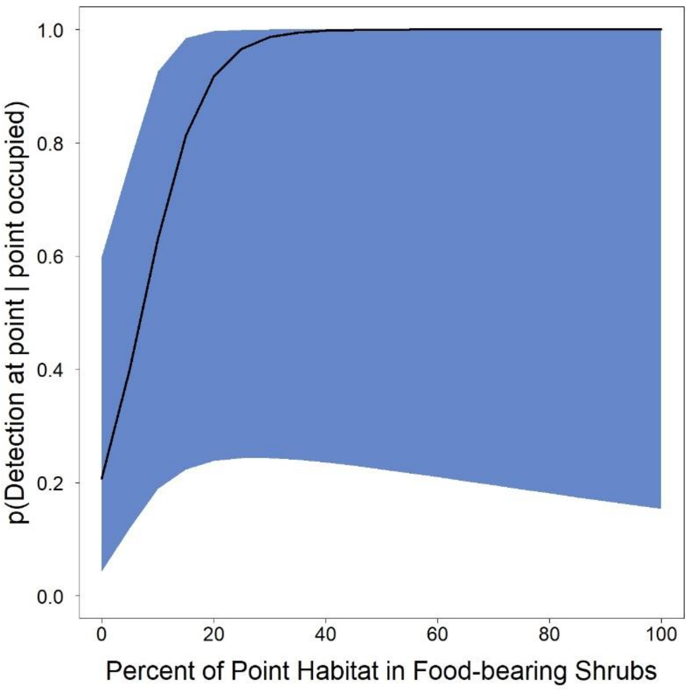

Figure 3. Covariate representing proportion of habitat in food-bearing shrubs (serviceberry, hawthorn, currant, elderberry, and snowberry) at a point predicting occupancy of the point by at least one Mountain Quail given that at least one Mountain Quail occupied the survey grid (Θ), represented with 95% confidence intervals.

In building the MaxEnt model for Mountain Quail, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 0.5) built with all presence/pseudo-absence records from 2016 and 2017 was 1.18, and the Area Under the Curve of the receiver operating characteristic plot (AUC) was 0.89. This represents a very good fit. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Annual Precipitation (worldclim.org bio_12), followed by Annual Mean Temperature (worldclim.org bio_1). Annual Precipitation (worldclim.org bio_12), followed by Precipitation of Driest Month (worldclim.org bio_14) decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables. Roughness, Annual Mean Temperature, Annual Precipitation, Mean Diurnal Range, Temperature Seasonality, Max Temperature of Warmest Month all had positive associations with presence, whereas, Elevation, Annual Precipitation, Precipitation of Wettest Month, and Precipitation of Driest Month had negative associations with Mountain Quail presence.

The MaxEnt model predictions for Mountain Quail, built from the 2016 and 2017 combined detections/pseudo-absences, present a very narrow predicted area of presence within the forest (Figure 2). While not illustrated, all detections from the 2003/2004 Idaho Department of Fish and Game surveys that were made within the forest boundary, all fall within areas of high predicted presence from the 2016/2017 MaxEnt model.

We had hoped that our more restricted stratum definition would result in a higher number of detections and for a sufficient number of detections to establish shrub level habitat associations. The number of detections was higher and we did find a positive association with food-bearing shrubs, consistent with other studies (Brennen 1991). Any management actions that promote the presence and growth of food-bearing shrubs is expected to benefit the species.

While the results were not entirely unexpected, we had hoped to detect Mountain Quail in previously unreported areas of the forest. After two years of surveys, our detections have largely been restricted to areas of previously known distribution. We suggest maintaining the 2017 survey stratum for future survey efforts to best measure any change in occupancy rates or any range expansion or contraction.

White-headed and Pileated Woodpeckers

We performed surveys for both White-headed and Pileated Woodpeckers across two separate strata. The first stratum was optimized for White-headed Woodpecker (WHWO stratum, about ½ size of the 2016 WHWO stratum), whereas the second stratum included Pileated Woodpecker habitat that was not included in the first stratum (PIWO stratum, about 50% larger than 2016 PIWO stratum).

For each woodpecker species we evaluated a combination of detection and habitat variables along with measuring the influence of the two strata on occupancy rates. Unique to the woodpecker projects we also generated three estimated densities of snags near the points – all snags, medium and larger snags (>6 inch Diameter at Breast Height [DBH]), and large snags (>16 inch DBH). At each point we recorded the distance to each observed snag using a laser rangefinder along with the height and size of the snag. We used distance sampling to generate an estimate of snag density for each sampled survey grid (Buckland et al. 2004). We evaluated each of the three snag densities within the model selection, but never in the same model. Only the top-ranking snag density size class was propagated through the model selection process.

White-headed Woodpecker

We surveyed for White-headed Woodpeckers in two strata. The first stratum (WHWO stratum) was based loosely upon habitat suitability models developed elsewhere (Latif et al. 2015), with some attributes relaxed to fit the expected NPCNF characteristics (e.g., low slope removed as a factor) and extended into areas where they may exist in low densities and may have gone undetect. The WHWO stratum was reduced in size from 2016 to focus on higher quality habitat. Published habitat suitability models emphasize the importance of Ponderosa Pine, but do not require it if all other attributes are favorable (Latif et al. 2015). To focus on the highest quality habitat, we restricted the 2017 stratum to only areas with a considerable presence of Ponderosa Pine. Additionally, the WHWO stratum consisted of areas with high canopy cover, and with areas of low canopy cover within 300m (clearings). One-kilometer square grids including at least 70% of this habitat type were included in the WHWO stratum.

The second stratum was the Pileated Woodpecker stratum (PIWO stratum) which included habitat for Pileated Woodpeckers that did not fit the WHWO stratum. Specifically, we chose all one-kilometer grids including at least 70% of forested landscape with large trees (>16 inches DBH) and with higher canopy cover (>25%), that were not previously included in the WHWO stratum. As the WHWO stratum was reduced in size in 2017, the PIWO was correspondingly increased in size to pick up much of the area that was removed from the WHWO stratum.

At all woodpecker survey grids, regardless of strata, we performed the same survey protocol consisting of six minutes of silent listening and then two-minute broadcast/silent for each of the two species (ten minutes total time per point). For each species, we omitted detections that only occurred during the playback of the other species (eight minutes total, six silent minutes, two broadcast minutes, per species). This condition did not affect the White-headed Woodpecker analysis as we never detected a White-headed Woodpecker only during the Pileated Woodpecker broadcast.

We detected White-headed Woodpeckers on seven of the 52 WHWO stratum routes and on none of the 20 PIWO stratum routes (Figure 4; Table 3). Additionally, our team reported six incidental observations of White-headed Woodpeckers on the Forest (Table 3).

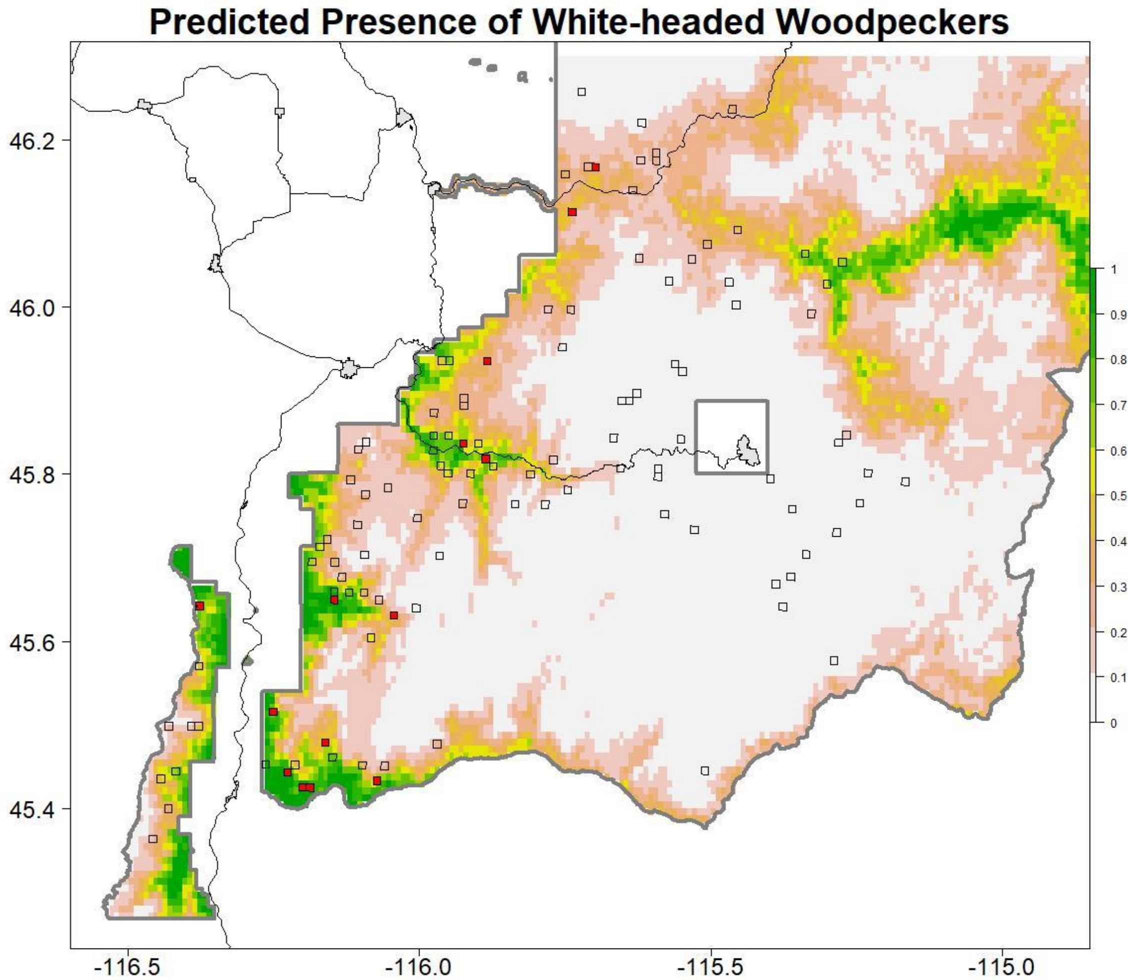

Figure 4. Completed White-headed Woodpecker surveys (squares), indicating presence (red) or no detection (hollow) overlaid on predicted White-headed Woodpecker distribution resulting from MaxEnt model combining results from both 2016 and 2017.

Table 3. Observations of White-headed Woodpeckers during 2017 survey efforts and incidental observations of White-headed Woodpeckers made between surveys. All coordinates in NAD83 datum.

Route, Point	Date	UTM Zone	UTM Northing	UTM Easting
WHWO-021,3	5/19/2017	11N	5076833	583167
WHWO-027,3	4/21/2017	11N	5030833	563167
WHWO-037,4	5/18/2017	11N	5074500	586833
WHWO-047,6	6/19/2017	11N	5040500	558167
WHWO-055,2	5/5/2017	11N	5053833	574500
WHWO-066,2	5/3/2017	11N	5054833	548500
WHWO-067,5	5/11/2017	11N	5032500	560500
WHWO-067,8	5/11/2017	11N	5032167	560500
WHWO-067,9	5/11/2017	11N	5032167	560167
Incidental		11N	5054730	565517
Incidental		11N	5034640	566751
Incidental		11N	5034812	566192
Incidental	4/1/2016	11N	5017738	547030
Incidental		11N	5015501	548166
Incidental		11N	5051757	549066

Consistent with the Pileated Woodpecker results and the results of other studies, the probability of detecting a White-headed Woodpecker at a point given that one was present, was much higher during the broadcast portion of the survey (Figure 5).

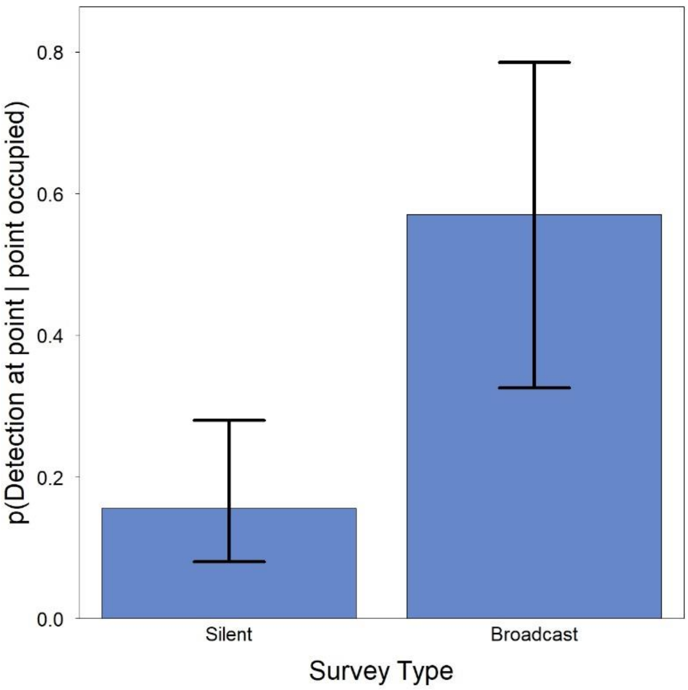

Figure 5. Covariates influencing the probability of detecting at least one White-headed Woodpecker at a point given that there was at least one White-headed Woodpecker at the point (p), represented with 95% confidence intervals.

The change in the stratum definition in 2017 resulted in an increased number of detections, that improved our model fitting process. Consistent with our 2016 results, White-headed Woodpeckers were more likely to be found in areas of low canopy cover, but increased proportion of Ponderosa Pine present relative to other tree species (Figure 6). Previous studies (e.g., Latif et al. 2015) have found an association of White-headed Woodpeckers with higher canopy cover. However, their study focused on the nest location, whereas, our results only represent survey locations. Latif et al. (2015) found that White-headed Woodpeckers prefer areas with higher canopy cover for nesting, but also prefer low canopy cover nearby (i.e., clearings), thus the overall canopy cover preference of an area may be lower than what is overall available in the forest. If true, this would be consistent with our results. Our results suggest a strong association of White-headed Woodpeckers with Ponderosa Pine. This finding is consistent with all previous literature (e.g., Garrett et al. 1996, Latif et al. 2015). Even though we included Ponderosa Pine presence within our stratum definition, we found White-headed Woodpeckers in areas where the stands were composed of higher amounts or entirely of Ponderosa Pine.

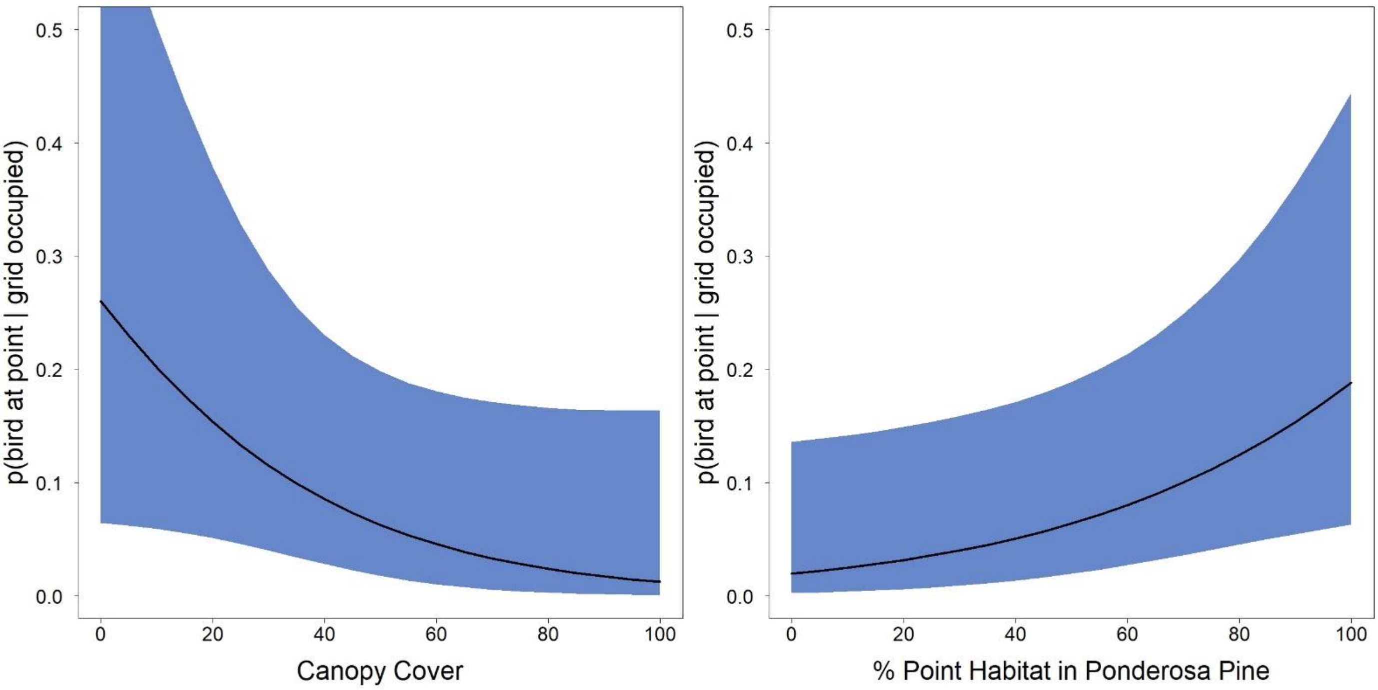

Figure 6. Covariates representing canopy cover and the percentage of local forest habitat composed of Ponderosa Pine at a point predicting occupancy of the point by at least one White-headed Woodpecker given that at least one White-headed Woodpecker occupies the survey grid (Θ), represented with 95% confidence intervals.

Lastly, we found that White-headed Woodpeckers had a strong association with the number of large snags present in the survey area, although the confidence interval is very wide (Figure 7). The confidence interval is very wide at high levels of large snag density as we rarely sampled landscapes with high density of large snags present (median density of large snags was 13 snags/ha). This association with large snag density meets expectations for woodpeckers in general and even more so for the White-headed Woodpecker, a species with a tight association with a large tree species such as Ponderosa Pine. This result is consistent with our 2016 results within the forest.

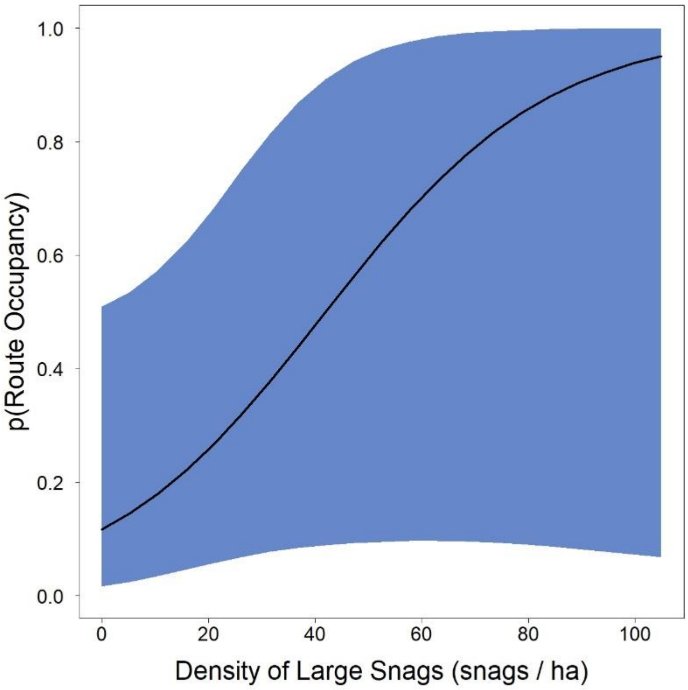

Figure 7. Covariate representing the density of large snags on the predicted occupancy of the grid by White-headed Woodpeckers (Ψ), represented with 95% confidence intervals.

Using the top model, we calculated the probability of detecting a White-headed Woodpecker given that one was present (p) without call broadcast to be 0.16 ± 0.05 [95% CI: 0.08 – 0.28], and with call broadcast to be 0.57 ± 0.13 [95% CI: 0.33 – 0.79]. We calculated point-scale occupancy (i.e., availability; Θ) to be 0.06 ± 0.04 [95% CI: 0.02 – 0.20]. We calculated overall transect-scale occupancy within the WHWO stratum (Ψ) to be 0.27 ± 0.17 [95% CI: 0.06 – 0.67]. As expected, the reduction of our stratum size resulted in increased estimate occupancy within the stratum and narrower confidence intervals.

In building the MaxEnt model for White-headed Woodpecker, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 0.5) built with all presence/pseudo-absence records from 2016 and 2017 was 0.84, and the Area Under the Curve of the receiver operating characteristic plot (AUC) was 0.87. This represents a very good fit. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Slope, followed by Roughness. Temperature Seasonality, followed by Precipitation Seasonality, decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables. Roughness, Slope, Annual Mean Temperature, and Max Temperature of Warmest Month, all had positive associations with presence, whereas, Elevation, Annual Precipitation, Precipitation of Wettest Month, Precipitation of Driest Month, Precipitation Seasonality, Mean Diurnal Range, and Temperature Seasonality all had negative associations with White-headed Woodpecker presence.

The MaxEnt model predictions for White-headed Woodpecker, built from the 2016 and 2017 combined detections/pseudo-absences, present a narrow predicted area of presence within the forest (Figure 4). However, the model suggests possible habitat on the eastern side of the forest within the wildness area that was not surveyed. A qualitative evaluation of the forest inventory data available is consistent in suggesting that this is an area of potential occupancy by White-headed Woodpeckers (e.g., presence of Ponderosa Pine).

From a management perspective, these results emphasize the importance of the retention of Ponderosa Pine snags within the forest. The degree of agreement that our results have with previous studies and the 2016 results for this program, helps to build confidence in our results. We suggest maintaining the 2017 survey strata for future survey efforts to best measure any change in occupancy rates or any range expansion or contraction. However, a targeted survey effort within the wilderness on the east side of the forest may also be warranted based upon inventory and management objectives.

Pileated Woodpecker

We performed surveys for Pileated Woodpeckers on both woodpecker strata (PIWO stratum and WHWO stratum). The White-headed Woodpecker stratum is very compatible with the expected habitat preferences of Pileated Woodpeckers. It is more restricted by favoring Ponderosa Pine, but may have lower overall canopy cover as it favors locations with dense cover and local clearings.

We detected Pileated Woodpeckers on 16 of the 20 routes within the PIWO stratum and on 41 of the 52 routes within the WHWO stratum (Figure 8). Survey observations and incidental observations are too numerous to report in tabular for in this document. GIS shapefiles will be provided to accompany this report.

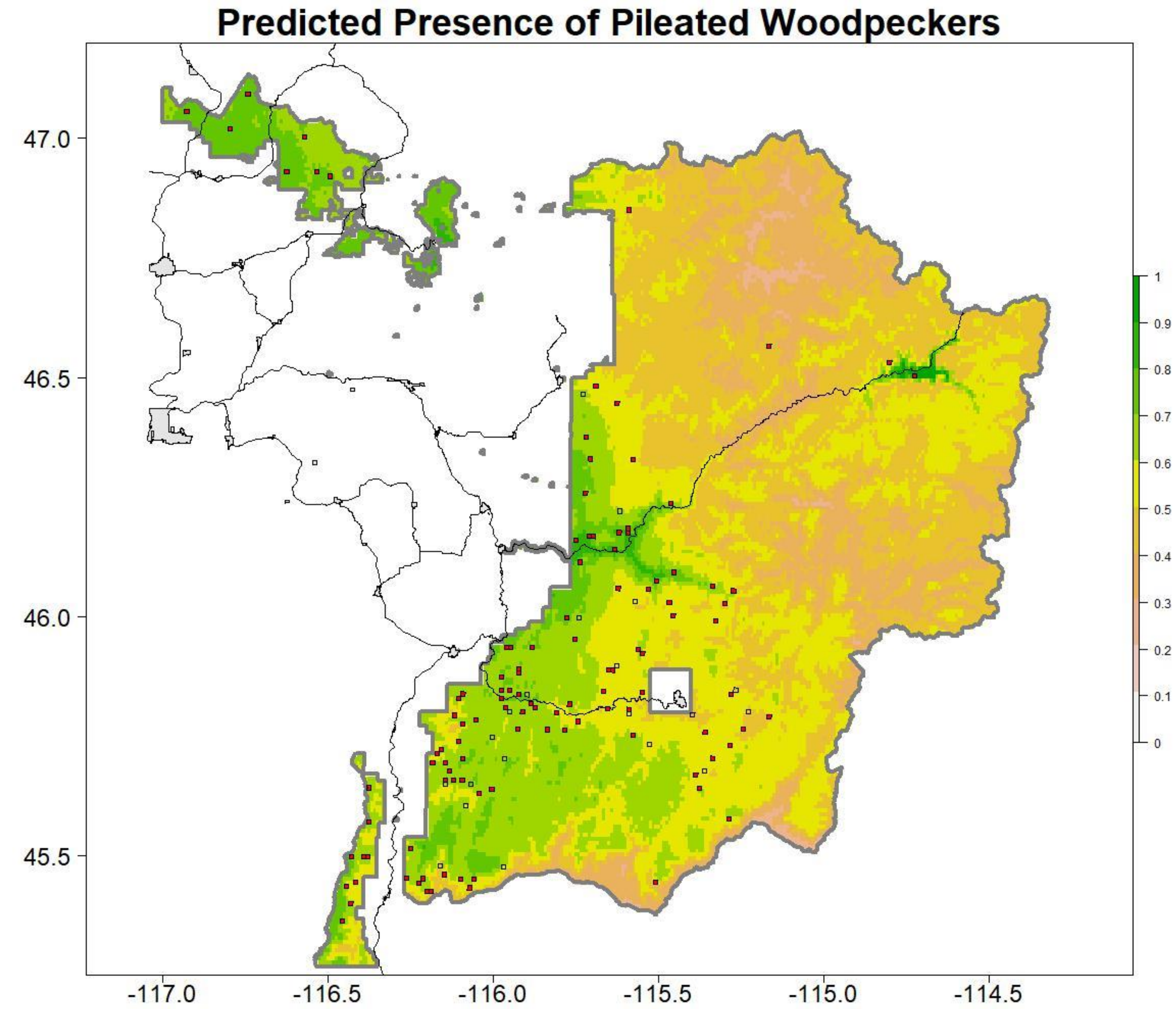

Figure 8. Completed Pileated Woodpecker surveys (squares), indicating presence (red) or no detection (hollow) overlaid on predicted Pileated Woodpecker distribution resulting from MaxEnt model combining results from both 2016 and 2017.

Within the multi-scale occupancy framework, we found survey type (silent/broadcast) to influence the probability of detecting at least one Pileated Woodpecker at a point given that there was at least one woodpecker at the point (*p*; Figure 9). As expected, broadcast surveys were much more effective for detecting Pileated Woodpeckers as their vocal response and likelihood of approaching the surveyor is very high in response to call playback. This finding is consistent with most if not all other woodpecker surveys.

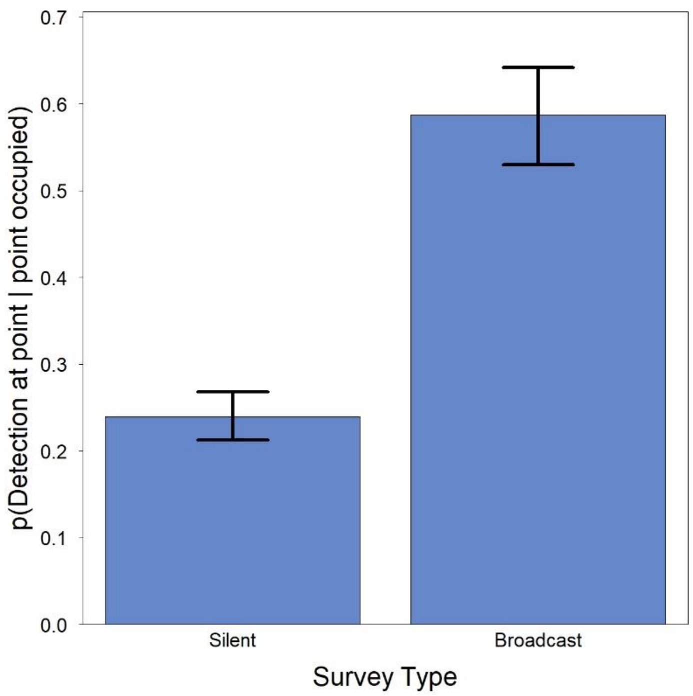

Figure 9. Covariates influencing the probability of detecting at least one Pileated Woodpecker at a point given that there was at least one Pileated Woodpecker at the point (p), represented with 95% confidence intervals.

Only one variable was identified as influencing point-scale occupancy – mean canopy height (Figure 10). Mean canopy height was selected as influencing the probability of at least one Pileated Woodpecker occupying a point given that at least one Pileated Woodpecker occupies the survey grid (Figure 10). Mean canopy height was chosen in 2016 along with a number of other variables. The simpler model chosen in 2017 versus 2016 likely represents the increase in PIWO stratum size relative to the number of surveys performed in this stratum (20, same as in 2016), and the reduction of WHWO stratum size to a more homogenous definition (decreased variance).

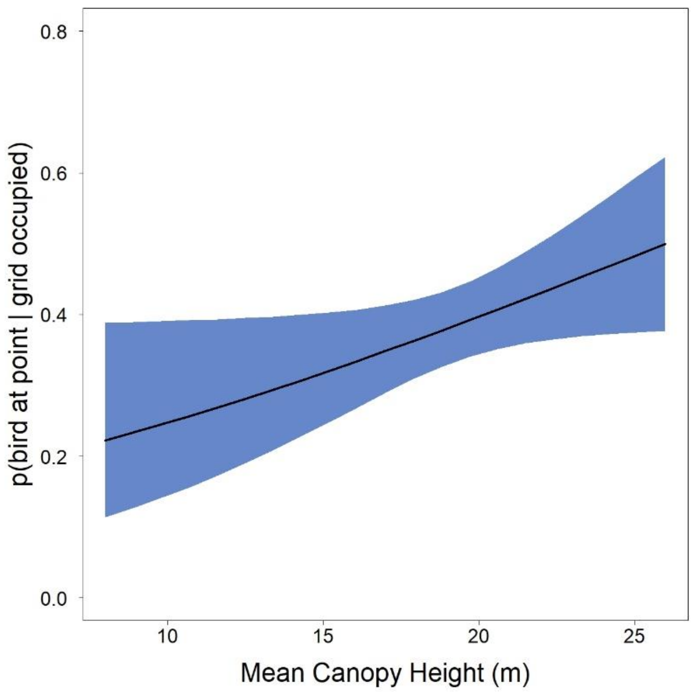

Figure 10. Covariates representing canopy structure at a point predicting occupancy of the point by at least one Pileated Woodpecker given that at least one Pileated Woodpecker occupies the survey grid (Θ), represented with 95% confidence intervals.

In 2016, we found that Pileated Woodpeckers were associated with grids with a higher number of large snags available as would be expected for most woodpecker species. In 2017, the number of large snags just missed being selected within our model selection procedure (competitive, but did not overcome the penalty for adding additional variables). There was essentially no difference in probability of occupancy between the WHWO and PIWO strata. (Figure 11).

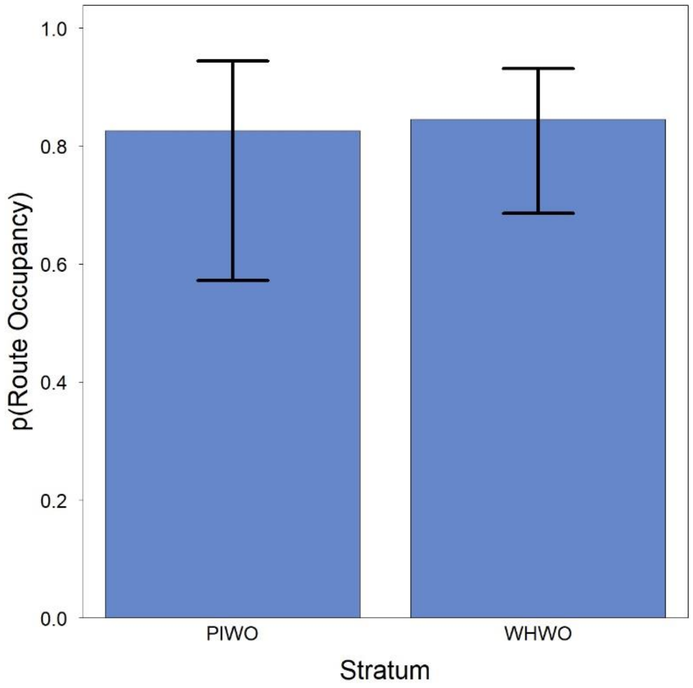

Figure 11. Predicted occupancy of the grid by Pileated Woodpeckers between WHWO and PIWO strata (Ψ), represented with 95% confidence intervals.

Using the top model, we calculated the probability of detecting a Pileated Woodpecker given that one was present (*p*) without call broadcast to be 0.24 ± 0.01 [95% CI: 0.21 – 0.27], and with call broadcast to be 0.59 ± 0.03 [95% CI: 0.53 – 0.64]. We calculated point-scale occupancy (i.e., availability; Θ) to be 0.32 ± 0.04 [95% CI: 0.24 – 0.40]. We calculated overall transect-scale occupancy (Ψ) within the PIWO stratum to be 0.83 ± 0.09 [95% CI: 0.57 – 0.94], and within the WHWO stratum to be 0.84 ± 0.06 [95% CI: 0.69 – 0.93].

In building the MaxEnt model for Pileated Woodpecker, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 0.5) built with all presence/pseudo-absence records from 2016 and 2017 was 0.03, and the Area Under the Curve of the receiver operating characteristic plot (AUC) was 0.58. A good fitting model should have a AUC value above 0.70. Our AUC of 0.58 does not represent a good fit, so caution in interpretation of the results is advised. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Annual Precipitation, followed by Precipitation Seasonality. Temperature Seasonality, followed by Annual Precipitation, decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables. Annual Mean Temperature, Precipitation of Wettest Month, Precipitation Seasonality and Max Temperature of Warmest Month, all had positive associations with presence, whereas, Elevation, Slope, Roughness, Annual Precipitation, Precipitation of Driest Month, Mean Diurnal Range, and Temperature Seasonality all had negative associations with Pileated Woodpecker presence.

The MaxEnt model predictions for Pileated Woodpecker, built from the 2016 and 2017 combined detections/pseudo-absences, present a broad predicted area of presence within the forest (Figure 8) with Pileated Woodpeckers possible across most of the forest. This map should be used with some caution due to the weak model fit and the high density of point sampling within the WHWO stratum in the southwest portion of the forest.

We suggest maintaining the 2017 survey strata for future survey efforts to best measure any change in occupancy rates. An increase in the number of samples across the forest would provide better habitat associations that might better inform management actions.

Northern Goshawk

We implemented two Northern Goshawk projects within the Forest. The first project was a random spatially-balanced survey across the forest with the intention of establishing statistically-rigorous occupancy rates among years and for comparison to the 2005 region-wide survey (Kowalski 2005). The second project involved checking the occupancy status of a select group of historical nesting locations and if found unoccupied, surveying the immediate vicinity of historical nest structures.

Northern Goshawk observation on survey grid north of Elk City. (Photo: Caleb Hansen)

Spatially-balanced Survey

We stratified the forest for Northern Goshawk surveys by choosing forest areas with higher canopy cover (>40%), larger trees (>10 inch DBH), lower slope (<50%), with aspects other than south or southwest, and primary tree species not Sub-alpine Fir (Reynolds et al. 1982, Younk and Bechard 1994, Finn et al. 2002, La Sorte et al. 2004, Miller et al. 2013). The stratum definition for spatially-balanced goshawk surveys remained unchanged between 2016 and 2017, but a new sample of grids was chosen in the hopes of finding goshawks in areas where they were not previously known to be present.

We detected Northern Goshawks on 14 of 65 survey routes within the forest (Figure 12; Table 4). We also report two detections that occurred at survey points, but after the six-minute survey interval and two additional incidental Northern Goshawk observations (Figure 12; Table 4).

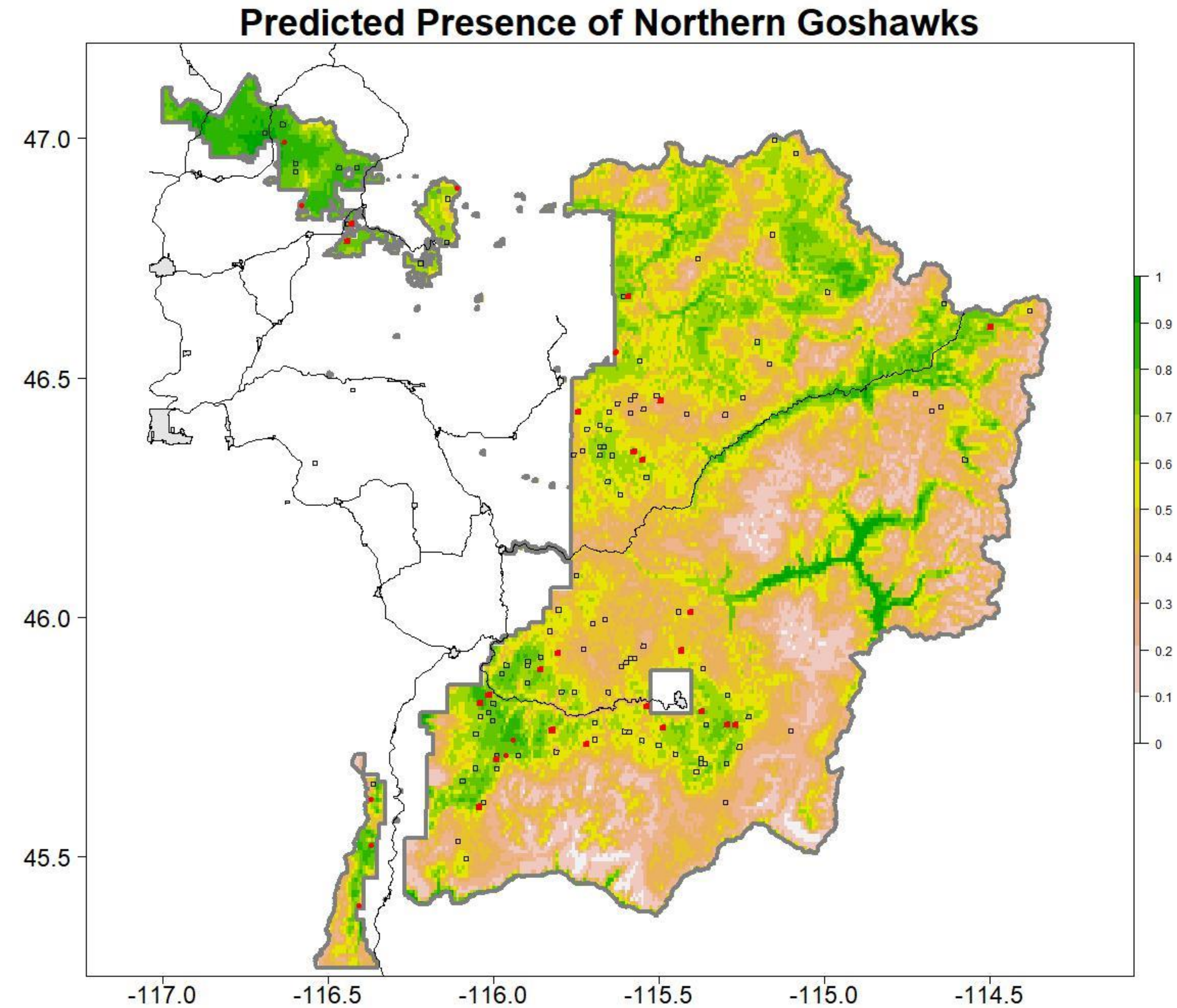

Figure 12. Completed Northern Goshawk surveys (squares) across the Nez Perce – Clearwater National Forest from both 2016 and 2017, indicating presence (red) or no detection (hollow) overlaid on predicted Northern Goshawk distribution resulting from MaxEnt model combining results from both 2016 and 2017

Table 4. Observations of Northern Goshawk detected during survey effort and incidentally, excluding historical nest check area (reported later in this document). Note, unlike woodpecker surveys, broadcasts for goshawks ceased after first detection on a route.

Route, Point	Date	UTM Zone	UTM Northing	UTM Easting
NOGON-002, 9	7/16/2017	11N	5086167	592167
NOGON-009, 7	7/9/2017	11N	5069167	617833
NOGON-011, 7	7/13/2017	11N	5096167	623833
NOGON-013, 5	7/1/2017	11N	5050500	574500
NOGON-014, 3	7/10/2017	11N	5070833	632166
NOGON-026, 9	7/10/2017	11N	5070167	634166
NOGON-027, 9	7/26/2017	11N	5142167	596166
NOGON-028, 1	7/6/2017	11N	5185833	543833
NOGON-029, 4	7/2/2017	11N	5061500	578833
NOGON-030, 9	7/11/2017	11N	5073167	626166
NOGON-035, 5	7/19/2017	11N	5131500	611500
NOGON-038, 4	6/28/2017	11N	5076500	576833
NOGON-059, 2	7/23/2017	11N	5145833	615500
NOGON-062, 3	7/18/2017	11N	5133833	609166
NOGON-042, 4 (after survey)	7/14/2017	11N	5072500	637833
NOGON-045, 9 (after survey)	7/5/2017	11N	5059167	578166
Incidental		11N	5080073	571538
Incidental		11N	5096415	627079

We evaluated several detection and habitat variables within our multi-scale occupancy framework including time-of-day, day-of-year, canopy cover, tree size, elevation, slope, and aspect. No variables were chosen as impacting occupancy of a given area by goshawks. This is likely the result of a very narrow stratum definition using many of these same variables, combined with the low number of detections during the survey.

Using the NULL model, we calculated the probability of detecting at least one goshawk at a point given that there was at least one goshawk at the point (p) using broadcast, to be 0.63 ± 0.08 [95% CI: 0.46 – 0.78]. We calculated the probability of at least one goshawk being at a point given that there was at least one within the grid (Θ), to be 0.42 ± 0.10 [95% CI: 0.25 – 0.61]. We calculated the probability of a given grid within our stratum being occupied by at least one goshawk (Ψ), to be 0.22 ± 0.05 [95% CI: 0.13 – 0.34]. We calculated a slightly higher occupancy rate in 2017 versus 2016, but still well within the confidence intervals (Figure 13).

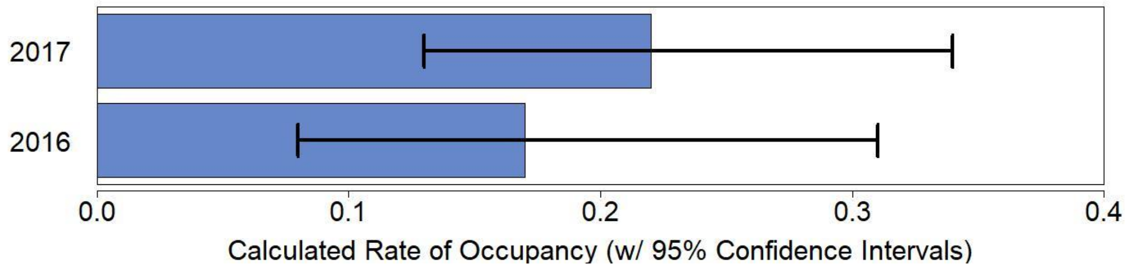

Figure 13. Calculated rate of 1km × 1km grid occupancy both Northern Goshawks for 2016 and 2017, each illustrated with 95% confidence intervals.

Kowalski (2005) performed goshawk surveys across the U.S. Forest Service Region 1 forests in 2005, including the NPCNF. Kowalski (2005) reported an estimated occupancy rate of 0.39 [95% CI: 0.29-0.50]. This rate is based upon a 697-ha survey grid randomly placed within forest lands. Our survey grids are smaller (i.e., expect lower occupancy rate) and placed in higher quality habitat (i.e., expect higher occupancy rate) and thus the numerical occupancy rates cannot be directly compared. We selected smaller grids in higher quality habitat to increase the distribution of land surveyed, to ensure we had an adequate sample size of grids with our level of investment, and to increase the chance of detecting previous unknown goshawk territories.

While we were not able to directly compare the occupancy numbers, we were able to simulate the spatial relationship between the two rates for indirect comparison (He and Condit 2007). Assuming that goshawk territories are randomly placed across a landscape with an assumed occupancy of 0.17 per 100 ha (our 2016 results), scaling up to the 697-ha sampling grid of Kowalski (2005) would produce a comparable occupancy rate of 0.67 ± 0.01. The calculation based upon 2017 results would produce an estimated comparable occupancy rate of 0.77 ± 0.01. These rates are considerably higher than the 0.39 estimated by Kowalski (2005) for two reasons: 1) goshawks territories are probably not randomly placed on the landscape as habitat is not random on the landscape (a clumped distribution would generate a lower occupancy rate when scaling up, but probably not by the margin reported [He and Condit 2007]); and 2) we surveyed higher quality habitat on average than Kowalski (2005). Qualitatively, the 2016 and 2017 results appear to support a conclusion that the Northern Goshawk is still doing well within the forest.

While the current program does not allow for direct comparison to Kowalski (2005), the current level of investment is not sufficient to produce a statistically rigorous program that would be directly comparable. We therefore recommend that we continue with the 2016/2017 program and stratum definition, and track changes in occupancy rates with the 2016 and 2017 estimates as we move forward. Moving to a random survey across forest lands would bring us closer to a direct comparison with Kowalski (2005), but would also decrease the number of detections and weaken any occupancy rates we can produce.

In building the MaxEnt model for Northern Goshawk, the regularized training gain for the best fitting model (Linear/Quadratic with regularization parameter 0.5) built with all presence/pseudo-absence records from 2016 and 2017 was 0.07, and the Area Under the Curve of the receiver operating characteristic plot (AUC) was 0.68. This represents a moderate, but not great fit, so caution in interpretation of the results is advised. From the jackknife test of variable importance, the single most important predictor variable, in terms of the gain produced by a one-variable model, was Elevation, followed by Annual Mean Temperature. Max Temperature of Warmest Month, followed by Mean Diurnal Range, decreased the gain the most when they were omitted from the full model, which suggests they contained the most predictive information not present in the other variables. Annual Mean Temperature, Annual Precipitation, Precipitation of Wettest Month, Precipitation Seasonality, Mean Diurnal Range, and Max Temperature of Warmest Month, all had positive associations with presence, whereas, Elevation, Slope, Roughness, Precipitation of Driest Month, and Temperature Seasonality, all had negative associations with Northern Goshawk presence.

The distribution map resulting from the MaxEnt analysis may be useful in future project evaluation, even though the fit was weaker than we had hoped. The geographic influences represented in the MaxEnt model are consistent with most other studies of Northern Goshawks (e.g., Finn et al. 2002, La Sorte et al. 2004, Miller et al. 2013). The climate influences are somewhat difficult to isolate as many are highly correlated, but the combined features would be expected to produce the mature forest structure upon which goshawks most often depend.

Historical Nest Checking

The IBO team was contracted to check the status of 20 historical goshawk territories within the Nez Perce – Clearwater National Forest. We visited 34 historical nest structures located within the 20 historical goshawk nesting territories to check the occupancy status of the structures, to search for new nest structures in the area, and to survey for goshawks within the area using a standard survey protocol (Table 5; Woodbridge and Hargis 2006).

Nest checking and surveying efforts produced observations, or lack thereof, that fit into a territory status model as proposed by Woodbridge and Hargis (2006). Note: these are territory status classification, not nest status classifications. We assigned values of “No Detection”, “Presence”, “Occupancy”, and “Breeding”. In some cases, we could confirm failure or success in areas where breeding was confirmed. “No Detection” should not be considered equivalent to “Not Occupied” as our survey protocol is only estimated to be 70% effective in detecting goshawks in an area. Also, some “No Detection” territories were not fully surveyed. “Presence” indicates that a bird was observed in the area on one occasion, but no evidence of breeding.

“Occupied” is assigned to territories where a bird was observed on at least two occasions, or a single bird was observed with evidence of nest orientation (perched at nest, fresh greenery on nest, molted feathers on ground near a nest, etc). Occupied does not imply that a pair of birds were present, only that at least a single bird was committed to the area (e.g., male goshawk defending a territory and looking for a mate). “Breeding” indicates the nest was still successful at the time of our surveys, but the nestlings had not yet reached an age of 34-days where we could classify the nest as “Successful”. “Breeding-Failed” indicates that there is evidence of a breeding attempt in the current year, but that attempt had failed prior to our last visit to the area. In a few cases, we were able to conclude “Breeding – Success” as the young were observed at an age of at least 34-days old or observed outside of the nest (Woodbridge and Hargis 2006).

We received a prioritized list of historical territories from the NPCNF. We checked historical nest structures if they could be found and then performed call broadcasts around the historical nest structures and at points spread 300m apart (Woodbridge and Hargis 2006), covering all area extending out to 500m from the structures. To ensure that all area out to 500m from the historical nest structure fell within 200m of a survey point, a minimum of 13 call points was established per territory, more when multiple historical nest structures were known.

Northern Goshawks were detected in 13 of the 20 territories that we monitored (Table 5). In some cases breeding was confirmed and even breeding success when nestling greater than 34-days-old or fledglings were observed (Woodbridge and Hargis 2006).

Table 5. 2017 status of historical Northern Goshawk territories within the Nez Perce – Clearwater National Forest, classified per Woodbridge and Hargis (2006).

Status	Territory	
No detection	Hem Creek Dead Horse Creek Little Bald Mountain Poorman Creek/Strychnine	D04-01 Elk Creek Falls Pistol Grip
Presence	American Creek D01-02	Cabin Creek Giant Cedar
Occupied	Crooked River Whitebird Creek	Merton Creek
Breeding – Unknown fate	Big Canyon	Papoose Creek
Breeding – Failed	---	
Breeding – Success	Big Bear Dry Fork	Center Ridge French Creek

Elk Creek Falls, near historical Northern Goshawk Territory (Photo: Caleb Hansen)

Conclusions

Our 2017 surveys were very successful in the continued monitoring for each of these important species. Our reduction in stratum size helped boost the detection rate of Mountain Quail and White-headed Woodpeckers to a point that statistical analyses could be performed and habitat associations could be identified. Many of the habitat associations identified were consistent with the literature, which increases our overall confidence in our occupancy metrics.

Based upon our set of results we have made some management recommendations and recommendations regarding the structure of these monitoring programs moving forward. In all cases, except for White-headed Woodpeckers, we recommend the 2017 strata definitions me maintained in future years. The stratum definition for White-headed Woodpeckers should be maintained in the southwest portion of the forest, but a wilderness survey in the east should be considered. IBO remains committed to working through these recommendations with the staff of the NPCNF.

Acknowledgements

We thank the Nez Perce – Clearwater National Forest for funding this effort. We further acknowledge the hard work and dedication exhibited by the survey team – Emma Gregory, Caleb Hansen, Carly Muench, and Marie Soderbergh. They remained professional, focused, and committed, through the long survey season and diversity of challenging conditions.

Literature Cited

Brennan, L.A. 1991. Regional Tests of a Mountain Quail Habitat Model. Northwestern Naturalist 72:100–108.

Brown, S.R, R.S. Ahl. 2011. The Region 1 Vegetation Mapping Program (VMap) Methodology. USDA Forest Service, Northern Region, CMIA Numbered Report 11-02.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2004. Advanced Distance Sampling : Estimating Abundance of Biological Populations. New York: Oxford University Press.

Burnham, K., and D. Anderson. 2002. Model selection and multi-model inference: a practical information-theoretic approach. Second Ed. Springer-Verlag, New York, New York, USA.

Dinkins, J.B., K.M. Brodhead, A.M. Charvoz, R.B. Sadak. DRAFT. Protocol and Data Collection for Management Indicator Species on the Nez Perce–Clearwater National Forest.

Fick, S.E. and R.J. Hijmans, 2017. Worldclim 2: New 1-km spatial resolution climate surfaces for global land areas. International Journal of Climatology.

Finn, S.P., J.M. Marzluff, and D.E. Varland. 2002. Effects of landscape and local habitat attributes on Northern Goshawk site occupancy in western Washington. Forest Science, 48, 427-436.

Garrett, K. L., M. G. Raphael, and R. D. Dixaon. 1996. White-Headed Woodpecker (*Picoides Albolarvatus*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from: http://birdsna.org/Species-Account/bna/species/whhwoo/introduction.

He, F., and R. Condit. 2007. "The Distribution of Species: Occupancy, Scale, and Rarity." *In* Scaling Biodiversity, 32–50. Cambridge University Press.

Hijmans, R. J., S. Phillips, J. Leathwick, and J. Elith. 2017. dismo: Species Distribution Modeling. R package version 1.1-4. [online] URL: https://CRAN.R-project.org/package=dismo

Kowalski, S. 2005. Frequency of Northern Goshawk Presence in the Northern Region 2005 Survey. Missoula, MT: Northern Region, USDA Forest Service.

La Sorte, F.A., R.W. Mannan, R.T. Reynolds, and T.G. Grubb. 2004. Habitat associations of sympatric Red-Tailed Hawks and Northern Goshawks on the Kaibab Plateau. The Journal of Wildlife Management 68:307-317.

Laake, J. L. 2014. RMark: An R interface for analysis of capture-recapture data with MARK. AFSC Processed Rep 2013-01, 25p. Alaska Fish. Science Center, Seattle, WA.

Landres, P. B., J. Verner, and J. W. Thomas. 1988. Ecological Uses of Vertebrate Indicator Species: A Critique. Conservation Biology 2:316–28.

Latif, Q. S., V. A. Saab, K. Mellen-Mclean, and J. G. Dudley. 2015. Evaluating Habitat Suitability Models for Nesting White-Headed Woodpeckers in Unburned Forest: Model Evaluation for White-Headed Woodpeckers. The Journal of Wildlife Management 79:263–273.

Mazerolle, M. J. 2015. AICcmodavg: Model selection and multimodel inference based on (Q)AIC(c). R package version: 2.0-3. [online] URL: http://CRAN.R-project.org/package=AICcmodavg.

Muscarella, R., P.J. Galante, M. Soley-Guardia, R.A. Boria, J. Kass, M. Uriarte, and R.P. Anderson. 2014. ENMeval: An R package for conducting spatially independent evaluations and estimating optimal model complexity for ecological niche models. Version 0.2.2. Methods in Ecology and Evolution 5:1198-1205.

Nichols, J. D., L. L. Bailey, A. F O'Connell Jr., N. W. Talancy, E. H. C. Grant, A. T. Gilbert, E. M. Annand, T. P. Husband, and J. E. Hines. 2008. Multi-scale occupancy estimation and modeling using multiple detection methods. Journal of Applied Ecology 45:1321–1329.

Pavlacky Jr., D. C., J. A. Blakesley, G. C. White, D. J. Hanni, and P. M. Lukacs. 2012. Hierarchical multi-scale occupancy estimation for monitoring wildlife populations. Journal of Wildlife Management 76:154–162.

Phillips, S. J., M. Dudík, R. E. Schapire. 2017. Maxent software for modeling species niches and distributions (Version 3.4.1). [online] URL: http://biodiversityinformatics.amnh.org/open_source/maxent/. Accessed on 16 September 2017.

R Core Team. 2017. R: a language and environment for statistical computing. Version 3.4.1. R Foundation for Statistical Computing, Vienna, Austria. [online] URL: http://www.R-project.org/

Reynolds, R.T., Meslow, E.C. and Wight, H.M. 1982. Nesting habitat of coexisting accipiter in Oregon. The Journal of Wildlife Management 46:124-138.

Shcheglovitova, M., and R. P. Anderson. 2013. Estimating optimal complexity for ecological niche models: A jackknife approach for species with small sample sizes. Ecological Modelling 269:9–17.

Stevens Jr., D. L., and A. R. Olsen. 2004. Spatially Balanced Sampling of Natural Resources. Journal of the American Statistical Association 99:262–278.

U. S. Geological Survey. 2010. National Land Cover Gap Analysis Project. http://gapanalysis.usgs.gov/

USDA Forest Service. 2011. Northern Region Threatened, Endangered and Sensitive Species. http://www.fs.usda.gov/detail/r1/plants-animals/?cid=stelprdb5130525

Vogel, C. A. 1994. Mountain Quail Habitat Suitability Study: Brownlee Wildlife Management Area. Idaho Department of Fish and Game, Nampa, ID, USA.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 Supplement:120–138.

Woodbridge, B., and C. D. Hargis. 2006. Northern Goshawk Inventory and Monitoring Technical Guide. Gen. Tech. Report WO-71. Washington Office: USDA Forest Service.

Younk, J.V. and Bechard, M.J. 1994. Breeding ecology of the Northern Goshawk in high-elevation aspen forests of northern Nevada. In Block, W.M., Morrison, M.L., and Reiser, M.H., Eds., The Northern Goshawk: Ecology and Management, Proceedings of a Symposium of the Cooper Ornithological Society, Sacramento, 14-15 April 1993, 119-121.

Appendix I: Datasheets

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Mountain Quail 2017

Page ___ of ___

Transcript:____________________________ Date:________________ Observer:_________________________________

Start P1:_____ Wind:____ Sky: _________ Temp:____ °F Start P2:______ Wind:___ Sky: ________ Temp:___ °F

Start P3:_____ Wind:____ Sky: _________ Temp:____ °F Start P4:______ Wind:___ Sky: ________ Temp:___ °F

Start P5:_____ Wind:____ Sky: _________ Temp:____ °F Start P6:______ Wind:___ Sky: ________ Temp:___ °F

Start P7:_____ Wind:____ Sky: _________ Temp:____ °F Start P8:______ Wind:___ Sky: ________ Temp:___ °F

Start P9:_____ Wind:____ Sky: _________ Temp:____ °F

Point #*	Species	Initial Dist.	Bearing	Min. Dist.	Broadcast Interval			Visual Y / N	# Birds	Comments
					1	2	3			

UTM Zone	UTM Easting	UTM Northing	Distance 2 cover (m)	Distance 2 water (m)	Min shrub height (m)	Max shrub height (m)	Percent shrub canopy	Dominant Shrub Species

Point #*	Species	Initial Dist.	Bearing	Min. Dist.	Broadcast Interval			Visual Y / N	# Birds	Comments
					1	2	3			

UTM Zone	UTM Easting	UTM Northing	Distance 2 cover (m)	Distance 2 water (m)	Min shrub height (m)	Max shrub height (m)	Percent shrub canopy	Dominant Shrub Species

Point #*	Species	Initial Dist.	Bearing	Min. Dist.	Broadcast Interval			Visual Y / N	# Birds	Comments
					1	2	3			

UTM Zone	UTM Easting	UTM Northing	Distance 2 cover (m)	Distance 2 water (m)	Min shrub height (m)	Max shrub height (m)	Percent shrub canopy	Dominant Shrub Species

Point #*	Species	Initial Dist.	Bearing	Min. Dist.	Broadcast Interval			Visual Y / N	# Birds	Comments
					1	2	3			

UTM Zone	UTM Easting	UTM Northing	Distance 2 cover (m)	Distance 2 water (m)	Min shrub height (m)	Max shrub height (m)	Percent shrub canopy	Dominant Shrub Species

*One observation block per group observed. Habitat refers to the location where the bird was first spotted.

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Mountain Quail Surveys 2017 - Veg

Transect:____________________ Date:________________ Observers:________________________________

						Overstory (% must total to 100%)									
Point	Cliff/ Rock	# Snags	Primary Habitat	Canopy Cover	Mean Canopy Ht	Spec #1	Spec 1 %	Spec #2	Spec 2 %	Spec #3	Spec 3 %	Spec #4	Spec 4 %	Spec #5	Spec 5 %
1															
2															
3															
4															
5															
6															
7															
8															
9															

	Understory (50 meters) (Spec totals must equal 100%)												Understory 15m radius					
Point	Cover %	Mean Height (m)	Spec #1	Spec 1 %	Spec #2	Spec 2 %	Spec #3	Spec 3 %	Spec #4	Spec 4 %	Spec #5	Spec 5 %	Dist H_2O	Dist Cov.	Min Ht	Max Ht	Cov. %	Dom Spec
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		

	Ground Cover (must total 100%)							
Point	% Snow	% Water	% Woody	% Dead Down	% Herbacious	% Bare Litter	% Dead Grass	% Live Grass
1								
2								
3								
4								
5								
6								
7								
8								
9								

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Woodpeckers 2017 Page ___ of ___

Transect:___________________________ Date:_________________ Observer:_________________________________

Start P1:_____ Wind:____ Sky: _________ Temp:____ °F Start P2:______ Wind:___ Sky: ________ Temp:___ °F

Start P3:_____ Wind:____ Sky: _________ Temp:____ °F Start P4:______ Wind:___ Sky: ________ Temp:___ °F

Start P5:_____ Wind:____ Sky: _________ Temp:____ °F Start P6:______ Wind:___ Sky: ________ Temp:___ °F

Start P7:_____ Wind:____ Sky: _________ Temp:____ °F Start P8:______ Wind:___ Sky: ________ Temp:___ °F

Start P9:_____ Wind:____ Sky: _________ Temp:____ °F

Point #*	Species	Initial Dist.	Bearing	Min. Dist.	Time Interval (Check all intervals)**										Visual Y / N	Age / Sex	Comments
					Silent						WHWO		PIWO				
					1	2	3	4	5	6	1	2	1	2			

*One line per individual bird observed (ALL woodpecker species). **Six 1 minute intervals of silent, followed by two 1 minute intervals of broadcasts for each species

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Nez Perce Clearwater Woodpecker Surveys 2017 - Veg

Transect:____________________ Date:________________ Observers:________________________________

						Overstory (% must total to 100%)									
Point	Cliff/ Rock	# Snags	Primary Habitat	Canopy Cover	Mean Canopy Ht	Spec #1	Spec 1 %	Spec #2	Spec 2 %	Spec #3	Spec 3 %	Spec #4	Spec 4 %	Spec #5	Spec 5 %
1															
2															
3															
4															
5															
6															
7															
8															
9															

	Understory (Spec totals must equal 100%)											
Point	Cover %	Mean Height (m)	Spec #1	Spec 1 %	Spec #2	Spec 2 %	Spec #3	Spec 3 %	Spec #4	Spec 4 %	Spec #5	Spec 5 %
1												
2												
3												
4												
5												
6												
7												
8												
9												

	Ground Cover (must total 100%)							
Point	% Snow	% Water	% Woody	% Dead Down	% Herbacious	% Bare Litter	% Dead Grass	% Live Grass
1								
2								
3								
4								
5								
6								
7								
8								
9								

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Page ____ of ____

Nez Perce Clearwater Woodpecker Surveys 2017 - SNAGS

Transect:____________________ Date:________________ Observers:________________________________

Point #*	Species If known	Distance (meters)	DBH Class Inches (circle)	Height class (circle)	% Bark (nearest 10%)	# Visible cavities
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		
			<6 6-16 >16	<5m 5-10m 10-15m 15-20m >20m		

* One line per individual snag visible from the survey point. Measure with rangefinder. Species codes: AS, LP, DF, GF, WP,...

Nez Perce Clearwater N. Goshawk 2017

BOISE STATE UNIVERSITY
INTERMOUNTAIN BIRD OBSERVATORY

Transect:_ __________________________ Date:________________ Observer:______________________________

Point	Time 24 hour	Wind 0 - 7	Sky Clear, PC, MC, Cloud	Temp F	Interval			Bearing	Init. dist.	Notes
					1	2	3			
1										
2										
3										
4										
5										
6										
7										
8										
9										

- Discontinue survey after detection. Search for nest for at least two hours. Can repeat broadcast at another point to help triangulate location, but best if wait for 30 minutes (call fatigue…). Make notes on zoomed in TOPO map.

Nez Perce Clearwater NOGO Historical 2017

Territory:______________________________ Date:____________ Observer:____________________

Nests:

Nest	Occu?	Zone	Easting	Northing	Tree Species	Tree Size	Tree Height	Canopy Cov.	Understory Den.

- Discontinue survey after detection. Search for nest for at least two hours. Can repeat broadcast at another point to help triangulate location, but best if wait for 30 minutes (call fatigue…). Make notes on zoomed in TOPO map.
- Understory Density: 1=360° flight access, ground access; 3=flight access from many directions, some ground access; 5= No under-canopy flight access (i.e., not viable).

Points Surveyed:

NOGO Observations:

Subjective Assessment of Viability of 500m Radius:

Viable (Yes/No):

Why: